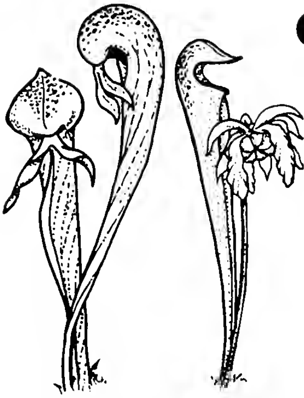
CARNIVOROUS PLANT NEWSLETTER

VOLUME 24, NUMBER 2 JUNE 1995



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Official Journal of the International Carnivorous Plant Society

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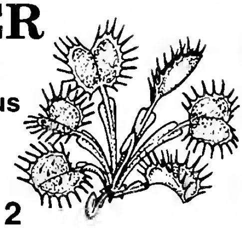

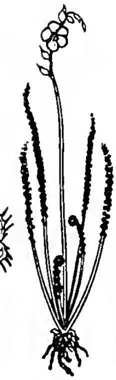

FRONT COVER: *Genlisea violacea* . Grown by Geoff Wong in clear container. Photo by Joe Mazrimas. (See comment this issue.)

BACK COVER: *Aldrovanda vesiculosa.* Grown and photo by Lubomir Adamec of the Czech Republic. (See comment this issue.)

The coeditors of CPN would like everyone to pay particular attention to the following policies regarding your dues to the ICPS.

All Correspondence regarding dues, address changes and missing issues should be sent to ICPS C/O Kevin Snively, P.O. Box 1013, Everett Wa. 98206-1013, U.S.A. or ICPS c/o Fullerton Arboretum, CSUF, Fullerton, CA 92634. DO NOT SEND TO THE COEDITORS. Checks for subscription and reprints should be made payable to ICPS.

All material for publication, comments and general correspondence about your plants, field trips or special noteworthy events relating to CP should be directed to one of the coeditors. We are interested in all news related to carnivorous plants and rely on the membership to supply us with this information so that we can share it with others.

Views expressed in this publication are those of the authors, not necessarily the editorial staff.

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PUBLISHER: The International Carnivorous Plant Society by the Fullerton Arboretum, California State University, Fullerton, CA 92634. Published quarterly with one volume annually. Desktop Publishing: Steve Baker, Rt. 1, Box 540-19AB, Conover, NC 28613. Printer: Kandid Litho, 1077 East Enda Place, Covina, CA 91724. Dues: $15.00 annually. $20.00 foreign. Reprints available by volume only

ISSN #0190-9215. Circulation 849 (194 new, 568 renewal).

ABOUT OUR COVERS THIS MONTH

While we have had many excellent covers in the past, this month's are rather special.

On the front cover, we see how Geoff Wong has cleverly grown *Genlisea violacea* in a shallow tray with holes in the bottom and setting over a clear container of water so that we can clearly see the twisted trap arms. A few years ago, very few people had genliseas in their collections; now, many of us have five or six species. But we rarely see the traps unless we unearth the plant, often damaging it. Photographing the traps has also been a challenge. But now we see them clearly and Joe Mazrimas has made a fine photo.

On our back cover, we see another happy anomaly. A few of us have tried growing *Aldrovanda vesiculosa* with varying success, usually keeping the plants for no more than a few seasons. When it has been grown, it was almost axiomatic that it never flowered in cultivation. Lubomir Adamec of the Institute of Botany in the Czech Republic not only grown the plant consistently well (outdoors, at that!), but as we can clearly see, it is flowering prolifically. He has even collected seed. Dr. Adamec has promised us an article on his methods and we look forward to it.

DS

THE SAVAGE GARDEN

"Imprinted"

by
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When I was a kid in the mid-sixties I had my first encounter with a venus flytrap. It was an ad in Famous Monsters magazine. It shouted something about the plant eating hamburger and had a fuzzy photo of Charles Darwin in it. I promptly had my mother write a check and mailed in my order. When they finally arrived they came in a styrofoam pot wrapped in plastic. The pot was filled with dry peat moss and three or four "bulbs", with all their leaves cut off. I followed the directions but nothing spectacular occurred. A few semi-developed leaves came up, and soon all the plants turned black.

My family had just recently moved to a seashore community in southern New Jersey, which bordered the Pine Barrens. We transplanted city folk were not always welcomed with opened arms by the local "Pineys", as housing developments went up one after the other along the coastal wetlands. But in school I became friends with a fellow named Russell, whose family lived in Tuckerton for a couple of hundred years. Russell's father raised "coon dogs", and the whole family spoke with a near-southern accent peculiar to the Pineys. it was Russell who told me, "I know where venus fly-catchers grow." I found this hard to believe.

He took me to Tuckerton Lake, right in the middle of town, on Route 9. This was a small lake of a few acres, the color of weak tea that the locals called "cedar water." One side ran along Route 9, adjacent to the two blocks of downtown Tuckerton. Ironically right across the highway was a salt-water lagoon lined with clamming docks. Tuckerton, which sits on the Great Bay north of Atlantic City, was once called "Clamtown." The southwest part of the lake was a public park and beach, where locals held barbecues and swam in the cold tea-colored waters. A few privately owned homes sat on the lake closest to the park and town, but most of this shallow, placid pool of water was wild and undeveloped, bordered by a mass of cedar trees and scrub, growing right into the edge of the lake.

It was Memorial Day weekend, and i could hear the picnickers at the park as Russell led me down the well-manicured lawn of a privately owned home that overlooked the lake. I was nervous about cutting through the yard but Russell assured me that the owner had bought one of his Paw's coon dogs and wouldn't mind. I could hear a dog barking from the house. Anyway, Russ said, this was the only way to get through the thicket that surrounded the lake. The lawn changed to a wall of pines, and we followed a well-used path down a gradual slope to the lake. The pines changed to southern white cedar. We had to stop. The trunks of the trees sat in water, and each trunk was surrounded by little islands of what Russell called sphagnum moss.

"There they are," Russell said, pointing.

I looked in awe at the strangest plants I had ever seen. Half-buried in the moss were rosetted clumps of deeply purple hollow leaves, with spiney collars and strange reddish flowers rising from the center. "These aren't venus flytraps," I said, but I was hardly disappointed. "My Paw says they eat bugs," Russell assured me, and sure enough when I peered into one of the hollow, leathery-looking leaves, i saw bugs swimming around in the wells of water each leaf held.

"Hey, what's this?" my friend said. He plucked something from the moss and held it up in his fingers. it was an image that would forever be imprinted upon my brain. A ray of sunlight broke through the cedars. shining directly on what Russell held in his hand. it was a small, circular, green leaf covered with hundreds of red tentacles like a pin-cushion, each ending in a tiny drop of dew. Every drop caught the light of the sun, and they sparkled and glittered like jewels.

"My Paw says these are flycatchers, too," Russell said. "They're all over the place."

I looked down at my feet. Sure enough, the spongy green and red moss appeared scattered with diamonds. These small plants were covered with dead and struggling insects, too. I looked around in awe, for it was a beautiful sight: tea-colored water, greyish trunks of cedars, billowy mounds of reddish-green sphagnum islands on which grew the strange plants that looked like they came from outer-space! I would never forget it, and had no idea how that moment would forever influence my life.

Russell and I dug up some of the weird plants and took them to school the following week. Even our teachers were mystified. But soon I was led to the library and to several books that answered my curiosity. What we had found growing on Tuckerton Lake were purple pitcher plants and sundews, carnivorous plants that, just like the venus flytrap, ate insects too!

My interest became a hobby. I read the few books and articles on the subject available at the time: from Paul Zahl's colorful pieces in National Geographic to Darwin's Insectivorous Plants. I was photographed at age 12 with my terrarium of CP in the local paper. I made my father drive me deep into the New Jersey Pine Barrens, where he would drop me off for hours at a time so I could slosh around in the bogs near

Batso. In my classes I daydreamed and doodled pictures of hooded pitcher plants and round-leaved sundews, and most of my school reports were somehow tied to CP. My mom called me a "fanatic", because I would sit for hours in front of my terrarium, staring hypnoid at these beautiful and strange plants. When my family drove south to Florida, I forced my Dad to drive us to Wilmington, North Carolina, so I could see trumpet plants and flytraps growing in the wild. In college at the University of Miami, I would hunt out butterworts in the hammocks of the Everglades. In California, cobra plants, just like Paul Zahl did thirty years before. Time has gone by, and I am still a fanatic. I still grow purple pitcher plants that I removed from Tuckerton Lake when I was a teenager. I left New Jersey and have lived in California for over twenty years.

A few years ago I returned to Tuckerton. My brother's family still lives there, just up the street and around the corner from Tuckerton Take.

I asked my eleven year old nephew Anthony if he wanted to visit the place where I had first discovered pitcher plants and sundews when I was around his age. He was very excited. and we took a walk to the lake.

The abandoned beach and picnic area was crowded with weeds. A sign at the brown water's edge read "Warning: Unsafe for Swimming". Anthony told me the lake was now polluted.

We snuck through the yard Russell had taken me to over two and half decades before. No one stopped us. We went down the path that lead through the thicket. We came to the water's edge. I stood there in shock, like a speechless idiot. I was physically trembling.

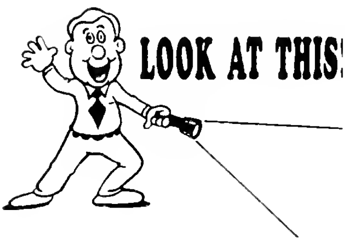
It was a Sunday, and the mud-covered bulldozer stood silent. What was once the picturesque lakeside border of bogs and cedars was now a ravaged slope of cleared mud, from the top of the hill to the water's edge. Just beyond the bulldozer was a mountain of debris the size of an eighteen-wheeler. Cut tree logs, crushed heaps of bushes, branches and brown, dying leaves. A huge monstrous trash pile. Scattered all over the ground, dried and crisp, were the carcasses of pitcher plants, atop a bed of crusty sphagnum criss-crossed by the deep ruts of heavy machinery. The foundation of a house was already in the ground. At the top of the hill a sign by the new road: Lake View Homesites. The developers were either kind enough or lazy enough to have left a cedar here, another there. At their bases in the muddy water we saw one or two pitcher plants, isolated survivors of what looked like a localized unnatural catastrophe. Couldn't they put in a house, I thought, without having to destroy everything around it?

My nephew picked up a shriveled leaf of *Sarracenia purpurea*. "is this a pitcher plant?" he asked. I told him it was. We couldn't find any sundews.

It took me a few years, but finally this spring I made a little mini-bog to memorialize that section of Tuckerton Lake. There are probably still a lot of pitcher plants and sundews on the far side of the lake, but who knows how far the housing development will eventually go, or the effects of water pollution.

I took a twelve inch plastic garden bowl and filled it with peat and sand. I planted a clone of my Tuckerton Lake purple pitcher plant, along with clumps of *Drosera rotundifolia*, *intermedia*, *filiformis* and the natural cross of the latter two species, *D.* x *hybrida*. I added a few pinches of live sphagnum, and scattered some dried pine needles and cedar leaves, but they were not from southern white cedars. I entitled this bog garden "New Jersey Pine Barrens" and set it out in our educational display at the nursery. But privately, I think of it as a little piece of Tuckerton Lake, a small but memorable part of my childhood, something my nephew Anthony might never see.

NEPENTHES DATING & MATING



I'm wondering if anyone is interested in the creation of a Nepenthes dating service. The system would allow more species breeding and, hopefully, cut down on all the haphazard hybridizing. If you are interested or have comments, please contact Tom Johnson at (818) 248-1623 or PO Box 12281, Glendale, CA 91224-0981.

The Truth About Carnivorous Plants is Hard to Find . . .

by
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And so it is. My name is Thomas Hanley and I have been growing Carnivorous Plants (CPs) for about 4 years. As with many people, it was simple fascination with one of nature's unique forms that held my attention. Fascination quickly gave way to the challenge of providing the specific conditions carnivores require. This, more than any other factor, has provided the opportunity to tie many aspects of my life into one enjoyable avocation which incorporates quality control, specialized systems, computers, and my true vocation: Illustration. Initially, given a few discarded *Sarracenia purpurea* and *Dionaea muscipula,* the plants did well with only long fiber peat moss and distilled water (Fig. 1). During this growing season the plants seamed to thrive and flower in simple containers. I based this success on the regularity of my watering and care taken that heat exposure did not reach extremes.

Fig. 1. *Sarracenia purpurea* and *Dionaea muscipula* in pot culture.

Preparing for the 1993 growing season, I realized that to provide specific care would require more detailed information. The ability to locate this information, I found, appears to be the most difficult aspect of raising CPs, as the following inquiries indicate:

Nurseries: While many local nurseries sell limited CPs each spring as an oddity, they are generally not inclined to provide specific information support due to limited resources or other market-driven agendas.

Libraries: Typically, only books geared for children are available without special orders from main branches. These books are usually overly simplistic, no longer current, or inaccurate.

Book Stores: Book stores can be very helpful in searching for existing titles on any subject. Given a little time they can find most ISDN titles. Obtaining a copy is another matter. Many books are no longer in print. A bigger problem is that, if the book is from a publisher not supported by their parent company, the book will be unavailable.

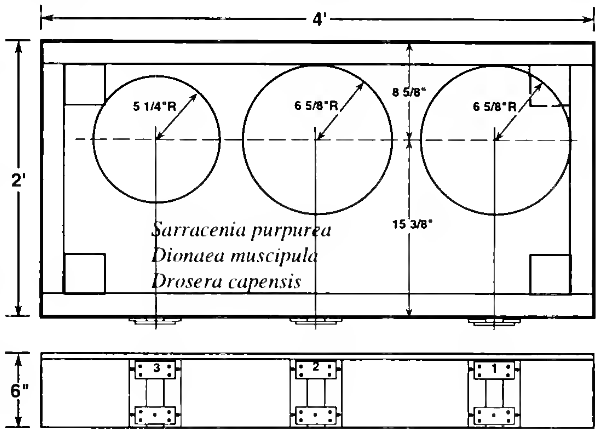
Garden Clubs: Many fine gardening clubs and societies are available to help on most subjects, but usually CPs lie somewhere outside their areas of expertise. Few home gardeners would want to recreate a

bog or swamp.

CPN: The CP Newsletter has been the best directional source of information to date. Luckily, a friend gave me a magazine article about Phil Sheridan's work with CPs. The ICPS was listed as a contact for more information.

After wintering in the garage with reduced watering, all plants were cleaned, crowns split if necessary, and transplanted into three large pots containing peat and vermiculite. A dedicated structure was then built to provide a safer, more accessible habitat for the plants.

During this growing season, several of the plants slowly decayed. I attributed this to the effects of top watering which caused compaction of the soil. Since I watered with filtered rain water, nothing suggested salt or mineral build-up. Time-lapse photographic experiments in progress did not permit repotting; as a result, soil compaction progressed and fungus became more of a problem due to a lack of oxygen.



Dedicated Structure Built in 1993

Gordon Cheers' book *Carnivorous Plants of the World* offered some insight into my problems. Unfortunately, it was not obtained until late November. By this time I had written a short article including a questionnaire and mailed it to individuals who had submitted material to the **CP Newsletter**. A high percentage returned detailed replies. Of greater note was that **Jerry B. Stahle, Sr.**, called long distance from New York to personally ensure I received the information needed most. Mr. Stahle provided a wealth of information on soil preparation, seed stratification, and care of *Dionaea* and *Drosera*. My thanks must go out to him!

Appling this information, the *Sarracenia purpurea* were cleaned, sprayed with fungicide, and placed in cold storage for winter. Drosera seeds obtained from **Tom Johnson** at the **ICPS Seed Bank** also began stratification using Mr. Stahle's directions.

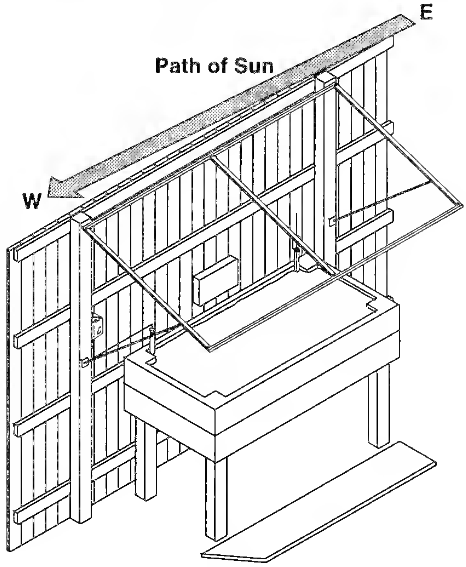
Spring 94 arrived presenting the opportunity to correct past mistakes and move forward. Winter had been put to good use locating any books or material available. Of all the titles listed in the CPN book list, three could be obtained: *Carnivorous Plants of the World* by **James and Patricia Pietropaolo**, *Carnivorous Plants of the United States and Canada* by **Donald E. Schnell**, and *Carnivorous Plants - Care and Cultivation* by **Marcel Lecoufle**.

After digesting the new information, I decided to convert the past season's structure into a simulated bog in the hope that a simple micro-climate could be established to better protect the plants from many of the stresses previously experienced. The goal was to establish a simulated habitat while actually decreasing workload and dependence on daily supervision if possible.

In converting the structure, the top was removed, sides extended to 12 inches, and

a reinforced bottom added. Fiberglas® cloth and resin provided an excellent method of sealing and protecting the wood while remaining inert with respect to the intended biology. An added benefit of Fiberglas® is that insect pests would not be able to puncture the containment as with plastic liners used in some ground bogs.

Once the conversion was completed the structure was positioned where it would receive almost unobstructed east/west sun. The peat was added, moistened, and allowed to age for about two weeks while waiting for live sphagnum to arrive from **Peter Pauls Nursery** in New York. By the time the live sphagnum arrived* most CPs had already been brought out of cold storage, cleaned, treated with fungicide and planted after a period of acclimatization in the garage. The live sphagnum was then simply spread over the entire surface and top watered frequently until it began to grow and spread. Originally I had intended to have the substrate composed of 8 inches of peat and 4 inches of live sphagnum on top. Having no experience in such matters I found it difficult to properly translate sphagnum sold by weight into area coverage. As my estimate was 50% low, the bog was topped by only 2 inches initially.



Modified Structure 1994

Officially, the bog was operational on 27 March 1994, requiring only the addition of support equipment to streamline day-to-day care and record keeping (Fig. 2). Meters from Edmund Scientific gave the ability to record air/soil temperatures and humidity. Water was introduced and measured directly at the bottom of the substrate using two aquarium uplift tubes and a home-built float mechanism indicating true height of water level.

Predicting that a bog of this type might require more than a gallon of water each day, it was essential that every opportunity be taken to collect and store rain water. Reflecting the requirement for decreased workload it was necessary to automate this process. Using the family camper as a watershed, a funnel was attached at the point of greatest run-off. Water conveyed down a plastic tube ran into a 32-gallon Rubbermaid® trashcan with integral lid. Three such containers were combined via siphon such that the water levels were linked. This modular system allows 96 gallons to be captured with no intervention.

With these modifications, the bog has been extremely successful with few exceptions. All plants exhibited strong, steady growth and the live sphagnum has actually tried to over grow the smaller plants. Several of the Sarracenias did not flower due to the late seasonal start, yet two *Sarracenia flava* have flowered in October. The most facinating aspect this season has been the stratified *Drosera* seeds(Fig. 3). Having spent 4 months in cold storage and acclimation, they were simply spread in large areas over the sphagnum thirty to 45 days latter, sundews began to spring up. By August, these had become beautiful banks of four different sundew species which are now

providing a rich supply of flowers and seeds.

It is now November 5 and I am planning further refinements based on this year's results. Most notably will be modifications to control the water table height at a constant level. It was found that the water table would fluctuate 1 inch for every half gallon used in an 8 to 12 hour period. This may have stressed some *Sarracenia* species. I plan to add an overflow drain and constant drip pump. This will be a closed system running through a sump so the pH of the substrate should not be affected.

Fig. 2. Thomas Hanley's planted bog structure.

Also, I am working with **Davis Instruments Co.** to modify some of their weather systems to provide automatic acquisition of the data I now collect manually each day. This would also allow integration of bog status via modem.

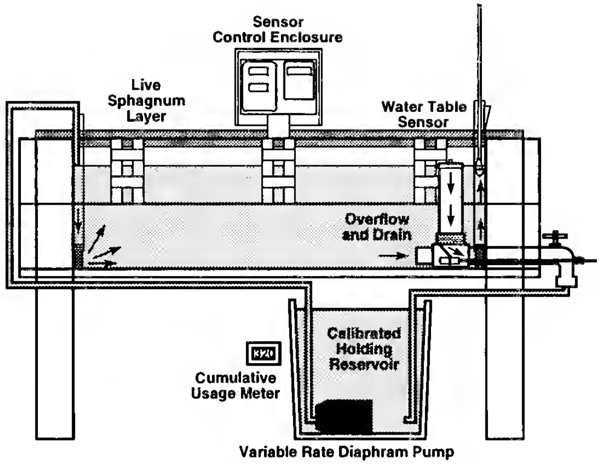
Fig. 3. Droseras grown from seed by Thomas Hanley in his bog structure.

Both of these system upgrades will free me to take trips etc. with much less concern over loss of plants or data. Once these systems are fully integrated and the results proven to be worthwhile, I hope that they can be applied on a larger scale for controlled testing of CP propagation issues and species protection.

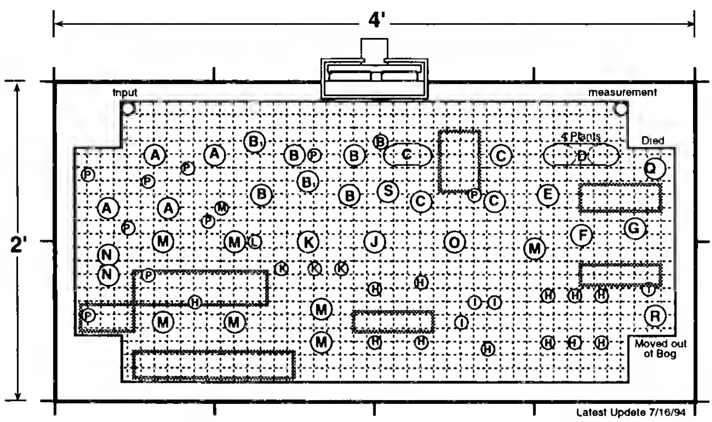
In closing, I would like to thank all who have helped achieve the improbable and

solicit information on the following issues:

1. Culture and care of live sphagnum.
2. Methods of seed harvesting (Sarracenia/Drosera).
3. Suggestions on winter care.
4. Comments on my systems or planned upgrades (Am I crazy?).
5. Addresses of any members in, or near, the Dallas/Ft. Worth area.
6. How and where to obtain any books available on Carnivorous Plants.
7. Exact environmental conditions found in the wild for different species.
8. Would any other members like to start an on-line forum? I am on America OnLine.



Planned Modifications for 1995



A : *Sarracenia flava* spp NC
B : *Sarracenia minor*
B_1 : *Sarracenia minor* "giant"
C : *Sarracenia leucophyllia*
D : *Sarracenia rubra* spp *gulfensis*
E : *Sarracenia flava*
F : *Sarracenia flava*
G : *Sarracenia alata*
H : *Dionaea muscipula*
☐ : *Drosera Intermedia/capillaris/roundifolia* species from seed
I : *Drosera capillaris*
J : *Sarracenia psittacina*
K : *Pinguicula vulgaris*
L : *Cephalotus folicularis*
M : *Sarracenia purpurea*
N : *Sarracenia rubra* spp *Wherryi*
O : *Drosera filimoris* spp *tracyi*
P : *Drosera capensis*
Q : *Primula vailii* (non CP)
R : *Nepenthes alata* "green"
S : Unknown Terrestrial Orchid

*Please note that in ordering live sphagnum other plants included in the same order required the good people at Peter Pauls Nursery to hold shipment until threat of freeze damage was no longer a concern. Sphagnum shipped by itself is not subject to this consideration as winter freezing is natural to its habitat.

HELIAMPHORA: THE NATURE OF ITS NURTURE

by

Don Schnell (Rt. 1, Box 145C, Pulaski, VA 24301, USA)

Considerable question of whether Heliamphora is truly carnivorous has arisen lately. These doubts largely have been related to accounts of short visits to various tepuis, usually in the 'dry" season, in which the visitors decry the paucity of anything for a respectable CP to eat. I used quotes around "dry" because these visitors will attest to the nightly cold, hard rains and heavy morning fog often lasting until past noon. The "dry" season is generally February to March.

As a result of trying to figure out how these pitcher plants get along with little to trap, and apparently no enzymes anyway, some novel proposals have been put forward on how they do survive. One recent one (Clayton, 1994) suggested that dust carried on prevailing winds from African deserts and then washed into the pitchers by rain provided nourishment, at least for the upland stands of pitcher plants since those occurring in the lowlands of the Gran Sabana had access to plenty of insects. This is an intriguing concept. It is certainly true that studies have shown that varying amounts of African desert dusts are carried to the New World daily. But before we assign the role of dustbin to Heliamphoras, let us examine some other evidence.

In October, 1970 Brewer-Carias, a dentist in Caracas who is also a naturalist, spent several days on top of Cerro de la Neblina (Mountain of the Mists) some 10,000 feet above the rain forest floor. Observing the tall *H. tatei* all day long, he noticed a steady stream of mosquitoes being trapped by the pitchers. The modified hood, called a spoon in this genus, was highly colored and developed in bright light and had a noticeable fragrance and abundant nectar production. He noted that the mosquitoes were attracted to the spoon initially and then fell into the pitchers. Often, several mosquitoes at once approached the spoon, became tangled, and fell into the pitcher. While he was up there, Brewer-Carias also determined the nature of the mechanical water level maintenance system of the pitchers. So here, we have observation of abundant flying insects being allured to and trapped by the pitchers.

In January and February of 1985, Renner spent 20 days on Cerro de la Neblina for the purpose of studying floral biology of *H. tatei* and other plants, particularly pollination mechanisms. Up until that time, it had been assumed that a paucity of insect life atop tepuis indicated that birds were the most likely pollinators. On the contrary, Renner effectively observed that an abundant bee fauna, particularly bumblebees on this 10,000 foot tepui, were the main pollinators of this species. In fact, the poricidal anther dictates that bee "buzzing" is necessary to release pollen. As we have observed in cultivated *Heliamphora* spp., pollen is not spontaneously shed. While Renner's observations pertain to pollination and not nutrition, they again testify to abundant insect life on this tepui.

So, what about other species on other tepuis? The answer is in a highly seminal paper (Jaffe, et al., 1992) written by four botanist who live in Venezuela. These people spent nine years studying all five *Heliamphora* spp. on eleven tepuis. Studies were conducted in the field as well as on plants in the lab. Proteolytic properties of fluid from open and unopened pitchers was measured using azoalbumin. Nutrient absorption was measured by ion extinction in solutions of phosphorus and potassium added to pitchers, and use of radio labeled amino acids. During field observations, numbers and

kinds of arthropods in the area were enumerated by netting as well as those captured by pitchers. This double census is vital since a different ratio of captured vs. ambient arthropods indicates preferential capture by possible luring. Similar studies on other pitcher plant genera have been flawed by not including the double census.

Vegetation on tepuis varies a great deal, something that can only be appreciated by visiting as many as these authors did. Roraima and Kukenan, for example have very sparse vegetation, very small pitcher plant populations compared to other tepuis, and few arthropods. Auyan, by contrast, has a robust vegetation, including forests of shrubs and trees to 3-10 m.

The workers confirmed Brewer-Carias' observation concerning the attractive value of the spoon. They also noted that tall pitchers (eg *H. tatei*) captured flying insects (mostly mosquitoes and other dipterids) while the remaining four smaller species captured prodigious quantities of ants, and the occasional large biomass beetle or scorpion. Mature but young pitchers have the highest quantity of freshly captured prey, while older pitchers were less active. *H. tatei* pitchers have waxy scales on the inside which break loose and cause prey to lose footing. Once the leaf opens, it fills with rainwater in addition to whatever fluid was inside prior to opening, and level is maintained by one of two leveling devices (pore or wing-channeling). After a few days of relatively dry weather, pitcher contents tend to dry with decrease in water level and prey-catching ability. Artificial addition of water causes capture to resume promptly. In addition to water absorption by roots, pitchers also absorb rain water foliarly. Water in the pitcher has a low surface tension, suggesting a wetting agent, which results in insects sinking and drowning sooner than if placed in pure water controls.

It was discovered that one species, *H. tatei* , does produce intrinsic enzymes secreted into pitcher fluid, but only in some stands on some tepuis. These enzymes were discovered on azoalbumin tests on sterile fluid aspirated from unopened pitchers.

Numbers of prey captured were of course proportional to total numbers of potential victims present, being very few on Roraima vs many on Auyan. Commensals also inhabited pitchers (similar to *Sarracenia* and *Darlingtonia* , including similar genera such as *Wyeomyia* and *Metriocnemus*). Occasionally, *Utricularia* spp. were seen growing in pitchers! Potassium, phosphorus and amino acids were all absorbed.

The authors conclude after these extensive studies that heliamphoras are indeed highly developed carnivorous plants and quite active in this respect where numbers of prey allow. The lack of instrinsic enzymes in four of the five species does not detract when one considers the situation with *Sarracenia purpurea* and *Darlingtonia* . In the former, rain-filling of pitchers is also very vital (hood erect). Bacteriolysis and activity of commensals contribute to digestion where intrinsic enzymes are lacking. Given the overwhelming evidence for carnivory generally in the genus, survival in spartan environs such as Roraima must depend on seasons and years richer in prey than others are. Furthermore, studies with sarracenias have indicated that pitchers are relative gluttens given the opportunity, and only a very small portion of what they actually catch is necessary to maintain the plant.

The paper by Jaffe is a "must read" for all those with a serious interest in *Heliamphora* carnivory and other aspects of physiology.

LITERATURE CITED —

Brewer-Carias, C. 1971. *In litt.*

Clayton, C. 1994. *Heliamphora* further explored. Bull. Austral. Carniv. Plant Soc. 13:12.

Jaffe, K, et. al. 1992. Carnivory in pitcher plants of the genus *Heliamphora* (Sarraceniaceae). New Phytol. 1 22:733-744.

Renner. S. 1989. Floral biological observations on *Heliamphora tatei* (Sarraceniaceae) and other plants from Cerro de la Neblina in Venezuela. PI. Syst. Evol. 163:21-29.

Oxygen budget in the traps of *Utricularia australis*

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Suction traps of the aquatic bladderwort *(Utricularia)* species are 1-5 mm wide bladders, the walls of which consists of only two layers of cells (see Lüttge, 1983, p. 501-504; Juniper et al., 1989, p. 64-71). During suction of a prey (firing), their luminal volume is increased by more than 40 % (Lüttge, 1983, p. 502). In aquatic bladderworts, the light-green traps contain chlorophyll and are capable of photosynthesis. Frequently, older traps become pigmented and their colour is rose to black (Knight, 1992). How prey is digested in *Utricularia* traps remains unclear, although microorganisms were shown to play a role (Juniper et al . 1989, p. 195).

The small volume of the traps together with their respiratory activity and that of the prey may cause the prey to die from anaerobiosis as recently hypothesized by Dr. Laurie E. Friday (Cambridge Univ.. U K.). Direct evidence is, however, lacking. Animals caught in the traps may stay alive for a certain period: Hegner (1926) investigated feeding of *Utricularia* traps by protozoa and observed that they had died after 75 min.

The aim of this study was to evaluate the oxygen budget in *Utricularia australis* traps based on measured values of their photosynthetic and respiration rates.

Utricularia australis R.Br. was cultivated outdoors or collected from a fishpond near the town of Trebon (Czech Republic). Net photosynthetic rate (PN) and dark respiration rate (DR) were estimated in a closed stirred chamber (8.6 ml) at a temperature of 22° C as linear parts of current response of a fine O_2-sensor in 20-min periods of light or darkness. The irradiance was 70 W.m-^{2} (400-700 nm). The experimental solution contained 1.04 mM $NaHCO_3$ and 1 mM KCI. and had a PH of 7.4. Thus, the initial $C0_2$ concentration was about 0.1 mM. Three groups of mature empty traps of different age and colour (32-51 traps) were selected (Table I). The pigment responsible for the dark colour of the traps was a red anthocyanin as was shown in diluted HCl. In other experiments (Table II), DR of intact empty traps,

halves of these traps, and of traps with prey, was measured. Results are expressed on either a fresh weight basis (after pressing out the luminal solution) or per trap. Values are the mean of 2-3 replicates.

PN values of *U. australis* traps depended greatly on trap age and/or colour (Table I). On fresh weight basis, PN in the young light-green traps was five times higher than in the old dark-pigmented ones. However. only a twofold difference was found in *U. macrorhiza* traps of different age while the range of PN was about the same as in *U. australis* (Knight. 1992). DR related to the FW did not differ so much between the three colour groups, and when related to one trap, DR values were the same. The DR values found in *U. australis* traps (see also Table II) are within the range of those measured in *U. macrorhiza* traps (Knight, 1992) and are about 2-3 times higher than those in *U. purpurea* (Moeller, 1978) and *U. vulgaris* shoots (Draxler, 1973). This is probably due to a high energy consumption in traps necessary for pumping out water. However, the mean Pm values in *U. australis* traps (Table 1) measured at 0.1 mM $C0^2$ were about 2-4 times lower than PN in *U. purpurea and U. vulgaris* shoots at lower $C0^2$ concentrations. Knight (1992) found in *U. macrorhiza* that the PN of leaves was 2-3 times higher than that of traps. This demonstrates that *Utricularia* traps are considerably less efficient photosynthetic organs than the shoots. In *Aldrovanda vesiculosa,* the PN value of traps was 67 % of that of shoots (Adamec. 1993. unpublished). These findings confirm the common theory that carnivory decreases PN of organs (Juniper et al., 1989, p. 145; Knight, 1992). In halved traps when both trap sides were exposed to the external solution no increase of DR was found as compared to the intact traps (Table II). The DR values of traps with prey were surprisingly slightly lower than those of empty traps.

What can be concluded from the above data? Firstly, photosynthesis in the traps is very low but it is still present even in dark-coloured traps. Secondly, marked oscillations of O_2 concentration may occur in the luminal solution between night and day (L. E. Friday). This may be partly independent of the 0_2 concentration in the ambient medium. Model calculations of the night luminal 0_2 concentration follow. The above measurements show the 0_2 consumption from the external solution, mainly by the external trap walls and trap structures. However, it may be assumed that 0_2 consumption from the luminal solution by the inner trap side occurs simultaneously before the internal 0_2 pool is exhausted. The cardinal question is what is the ratio of the "external" and "internal" respiration rates when 0_2 concentrations inside and outside the traps approach a saturation level (ca. 9.0 mg O_2.1-1). Owing to certain symmetry of the trap walls, we can assume that the "internal" DR is at least 10 % of the "external" one measured. This is about 0.02 µg O_2.h^{-1} in the case of a middle- aged, rose-grey, trap of a volume of ca. 2.51 µl (Table I; trap diam. 2.0 mm, trap width 0 8 mm). Such a dark respiration rate would reduce the internal O_2 concentration by 8.0 mg 0_2.l^{-1}.h^{-1}. Thus, the saturation O_2 level of ca. 9.0 mg.l^{-1} may be exhausted theoretically within 68 min. In smaller traps (vol. 1.78 µl; see Table II), the depletion of internal O_2 would occur within only 33 min.

Respiration activity of a possible prey was also taken into account. *U. australis* traps are able to catch only very small zooplankton species, e.g. *Chydorus sphaericus,* small *Bosmina* or ostracods. Dry weight of this kind of prey is about 2 µg (Jorgensen, 1979, p. 229-230) and their respiration rate is rather variable within 0.037-1.56 µg 0_2.h^{-1}.prey^{-1} at 20-26°C (Jorgensen, 1979, p. 250-252). In the traps stated in Table I (vol. 2.51 µl), the saturation level of O_2 should be exhausted by one prey theoretically within 0.9-37 min and the prey could die of anaerobiosis. However, in the traps stated in Table II, the prey (fine ostracods) survived in dim light or darkness at least for 8 h.

Experiments in Table II were performed to distinguish the "external" and "internal" DR. However, no increase in DR was found either in halved traps with both external and inner sides exposed to the experimental solution or in the traps with prey. These results contradict each other: the former treatment indicates that the internal 0_2 consumption by the intact traps is permanently compensated by 0_2 diffusion from the external medium whereas the latter shows that the luminal solution is isolated from the outside. All the traps studied were obviously after firing and were pumping out water. In any case, the speculations on the 0_2 concentration inside the traps cannot substitute for a direct measurement of 0_2 concentration by an 0_2-microsensor,

ACKNOWLEDGEMENT

Sincere thanks are due to Dr. Laurie E. Friday, Univ. Cambridge. U. K. for valuable suggestions and discussion.

Table I. Net photosynthetic and respiration rates of empty traps of different age and colour. The mean trap size was 2.0-2.2 mm and the width 0.8 mm. Mean fresh weight (FW) of a trap is given.

Age and colour of traps	Mean trap FW (mg)	Photosynthesis mg 0_2 g.h	Photosynthesis µg 0_2 trap.h	Respiration mg 0_2 g.h	Respiration µg 0_2 trap.h
young, light green	0.55	0.54	0.30	0.38	0.21
older, rose-grey	0.83	0.31	0.26	0.25	0.20
older. blue-black	0.87	0.11	0.09	0.25	0.22

Table II. Respiration rates of intact empty traps and of these traps after they had been halved. The young traps with prey contained each 1-2 small ostracods (ca. 0.6 mm) and some of the prey was still alive during the measurement. The mean trap size was about 1.8 mm and the width 0.7 mm. Mean fresh weight of one trap is given.

Type and treatment of traps	Mean trap FW (mg)	Respiration mg 0_2 g.h	Respiration µq O_2 trap.h
intact empty young traps	0.77	0.38	0.29
halved young traps	0.77	0.34	0.26
young trapswith prey	0.85	0.32	0.27

REFERENCES

Draxler G., 1973. Gaswechselmessungen an *Utricularia vulgaris.* In: Ellenberg H. (ed.), Okosystemforschung. Springer, Berlin, pp. 103-107

Hegner R. W., 1926. The interrelationships of protozoa and the utricles of *Utricularia.* Biol. Bull. 50: 239-270.

Jorgensen S. E. (ed.), 1979. Handbook of Environmental Data and Ecological Parameters. Pp. 1162, ISEM, Copenhagen.

Juniper B. R., Robins R. J., Joel D. M.. 1989. Carnivorous Plants. Pp. 353, Academic Press Ltd, London,

Knight S. E., 1992. Costs of carnivory in the common bladderwort. *Utricularia macrorhiza.* Oecologia (Berlin) 89: 348-355.

Lüttge U., 1983. Ecophysiology of carnivorous plants. In: Lange 0. L.. Nobel P. S., Osmond C. B., Ziegler H. (eds.). Encyclopedia of Plant Physiology, New Series. Vol. 12C Berlin-Heidelberg-New York, pp, 489-517.

Moeller R. E., 1978. Carbon-uptake by the submerged hydrophyte *Utricularia purpurea.* Aquat. Bot. 5: 209-216.

Southeastern CP Meeting Planned.....

Mark your calendars for the up coming Southeastern CP meeting hosted by Larry Mellichamp at UNC Charlotte. Lot of things are planned for this 2nd annual meeting. This year there will be a field trip to a local bog, talks on all CP's, and a plant swap and auction. As in the last year we will have a Friday night gathering to get to know the attendees. The meeting is set in Charlotte, NC on September 22, 23, and 24, 1995. All are invited and more will be mailed at a later date to the southeast area. If you wish to attend or help with this meeting please contact Larry Mellichamp at UNC Charlotte, DEPT. OF BIOLOGY, Charlotte, NC 28223 or Steve Baker, Rt. 1, Box 540-19AB, Conover, NC 28613, 704-256-7035. Hope to see you there.

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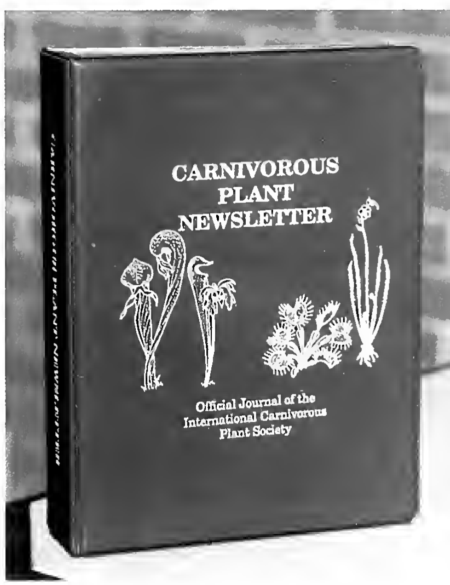

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Sarracenia flava Varieties: Do We Know What We, Are Talking About?

by
Don Schnell (Rt. 1, Box 145C, Pulaski, VA 24301, USA)

Hardly a month goes by that I do not receive requests for seeds or plants of various *Sarracenia flava* "varieties", such as v. *rugelii* or v. *crispata*. The correspondent seems somewhat stunned when I write back asking them for a description of what they want. They seem confused that I may not be acquainted with these "well-accepted" varieties.

As often happens over time and many writings and rewritings, the various varietal terms have become confused, sort of like the classic game where a line of students whispers something in the ear of a neighbor and asks them to repeat it down the line, and what comes out is often quite different from what started at the other end.

The start is mainly a paper written by M. T. Masters for The Gardeners' Chronicle, a British publication, in 1881. The "other end" is probably assumptions based on difficulties in making Latin translations from Macfarlane's Das Pflanzenreich monograph of 1908, and the general unavailability of Masters' original article.

I thought it would be useful to review what Masters meant by these different varieties, if we could figure it out from his descriptions. Some of you will not be pleased with the results since they are quite at odds with many common assumptions. We can only blame McDaniel for one thing in his 1966 doctoral dissertation, and that is a typo wherein he called Masters' v. *atrosanquinea* v. *atropurpurea* , so we can strike *atropurpurea* right now. Macfarlane named a new variety, v. *media* , in his monograph. Translated from the Latin, he describes "a pitcher of medium stature, throat dark red with red veins radiating out". This actually sounds rather uninteresting and nondescript. I think this is likely one of the hybrids between the primary five variants on the Carolinas coastal plain (e.g. Schnell, 1978), and so we can drop that one. I would be especially cautious of using "small, medium and large" in describing *S. flava* variants since size among them is so much a function of age and growing conditions.

McDaniel does not describe any variants in his monograph but merely lists them. Macfarlane offers abbreviated descriptions from Masters but they are in Latin as is his entire monograph. So we must go back to Masters in 1981 to look at some of the most prominent variants.

<u>var. *ornata*</u> — This epithet is rather descriptive in that it is indeed, in my opinion, one of the most ornate pitchers. "..a rather large form with green pitchers traversed with red veins, the inner surface of the large lid being especially <u>marked</u> with a network of red veins..." This sounds a lot like the heavily veined form of the Carolinas coastal plain. But, one wonders about the degree of venation, although he uses "especially", which is helpful. I underlined <u>marked</u> for a special reason to be discussed later. So, I think this one is pretty clear-cut, and nicely matches his Fig. 3 as the heavily veined variant.

<u>var. *rugelii*</u> — "One of the large forms, with the lid of the pitcher <u>well marked</u> (underline mine) and strongly blotched with crimson at the base." This is one of the most popularly discussed variants, and is usually referred to the Gulf coastal plants which have a large, unveined yellow-green lid, purple blotch in the throat and no or few

veins in the pitcher. These are probably *not* the same! Notice that he describes the lid as "well marked". Now, does well marked mean with veins (as in the clearly "marked" I underlined in var. *ornata*), or does it mean marked in the sense of large, prominent, etc. Since Masters has already used "marked" to mean marked by veins, then the Gulf coastal plants are clearly <u>not</u> var. *rugelii*! We should probably stop using that epithet for the Gulf plants.

Curiously. Macfarlane adds to the confusion by an omission: "Folia magna, fauce ascidii et basi operculi purpurea." Translated, "Leaf large, throat of pitcher and base of lid deep red." He forgot the "well marked"

<u>var. *maxima*</u> — This seems easy—Maxima means "large", so this probably means any large, typical *S. flava* that one finds in the Carolinas piedmont, for instance. Right? Wrong! "...differs only...in the pitchers, and their lids, being wholly green." So, var. *maxima* is our all-green variant of the Carolinas coastal plain; nothing really to do with size!

<u>var. *crispata*</u> — "...very remarkable variety ... green with prominent nerves(he means red venation), and with deeper wing ... strongly reflected sepals, the <u>white</u> (underline mine) petals, ...blunter ovary ... lid erect, incurved, ovate acute or tall-pointed, contracted at the base." What does it sound like?-*S. alata* , of course! So that eliminates var. *crispata* Masters *sensu stricto*. In all fairness, Masters does wonder in writing if this might not be a separate species.

<u>var. *atrosanguinea*</u> (probably incorrectly McDaniel's listed var. *atropurpurea* referred to the Masters article we are quoting) - "..relatively small form...lid ovate-acute, deeply stained wit red." Then he refers to his Fig. 4, which is obviously one of the *S. rubra* sspp. The written description is obviously rather vague, and I think most people referred this variant name to the all-red form of the Carolinas coast, because of what the name sounds like, really pushing redo So, we can drop this one, too.

I think the main lesson of all this is to go back to original literature as much as possible. In this case, it is relatively easy since we all have access to libraries directly or through interlibrary loan. In other problem areas, such as looking for the types of *Sarracenia purpurea* or *Drosera anglica* , it is far from easy!

We must also realize that Masters was writing from Britain in the latter 19th century and had only experienced *S. flava* from horticultural specimens and a few herbarium sheets. A great deal of field experience is necessary to even begin to appreciate the polymorphism of this species.

A second lesson may be that little is as it seems. var *maxima* may be small or large, but the key factor is its all-green pitcher color in the original description. Perhaps it is also somewhat disappointing that McDaniel did not address these variants at all in his easily accessible monograph which seems to be widely distributed.

<u>LITERATURE CITED</u>

Macfarlane, JM. 1908. Sarraceniaceae, in A. Engler: Das Pflanzenreich, IV. 11O., p. 1-3 9.

Masters, MT. 188 1. Sarracenias. Gardeners' Chronicle. 16:11-12, 40-41.

McDaniel, S.1966. A taxonomic revision of *Sarrcenia* (Sarraceniaceae). PhD dissertation, Florida State University. (University Microfilms, Ann Arbor, MI 48106, No. 67-345)

Schnell DE. 1978. *Sarracenia flava* L.: Intraspecific variation in eastern North Carolina. Castanea 43:1-20.

Photosynthetic Inorganic Carbon Use by Aquatic Carnivorous Plants

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Photosynthetic uptake of inorganic carbon by submerged aquatic plants is limited mostly by the concentration of inorganic carbon and light availability. It is generally accepted that aquatic plants compete for inorganic carbon and that use of HCO_3^- as a carbon source is ecologically advantageous in standing waters (Allen and Spence, 1981; Maberly and Spence, 1983). CO^2 concentration in waters depends strongly on pH, according to the following equation (Helder, 1988):

$$pH = 6.37 + \log([HCO_3^-] / [CO_2]).$$

Thus. the lower the PH is at a given total alkalinity (TA),

$$TA = [HCO_3^-] + 2.[CO_3^{-2}] + [OH^-] + [H^+]),$$

the higher is the CO_2 concentration in water.

The majority of aquatic carnivorous species usually grow in soft or medium-hard, acid or neutral, dystrophic waters; but some species of *Utricularia* may grow in hard and slightly alkaline waters (Komiya, 1966; Moeller, 1978; Kadono, 1982; Fraser et al., 1986; Arts and Leuven, 1988; Hough and Fornwall, 1988). These species can grow in waters that differ widely in TA and pH conditions (Kadono, 1982; Fraser et al., 1986; Arts and Leuven, 1988) and at very different CO_2 and HCO_3^- concentrations. Aquatic plants are plastic concerning their photosynthetic affinity for CO_2 and HCO_3^- and are able to change the affinities according to the ratio of CO_2/HCO_3^- concentrations in water (Sand-Jensen and Gordon, 1986). In studies performed so far, *Utricularia purpurea* (Moeller, 1978) and *U. vulgaris* (Hough and Fornwall, 1988) were found to use only CO_2. Aquatic carnivorous plants either have strict or facultative requirements for organic substances in water (Ashida, 1937). These substances enhance plant growth substantially while some of the organic compounds used by the plants are taken up from water, and the plants probably also use organic compounds derived from prey bodies (for a review see Lüttge. 1983, p. 492-493; Juniper et al., 1989: p. 131). In this paper, three European aquatic *Utricularia* species and *Aldrovanda vesiculosa* were tested for HCO_3^- use and CO_2 affinity,

Utricularia australis R.Br. and *U. minor* L. were collected from sites in the Ceska Lipa

District, N. Bohemia, Czech Republic. pH values in these stands were measured using a combined pH electrode and a battery-powered pH meter (+O.1 pH). *Utricularia vulgaris* L. and *Aldrovanda vesiculosa* L. plants used for the experiments were grown in an outdoor culture at the Institute of Botany in Trebon, Czech Republic. Eurasian water milfoil, *Myriophyllum spicatum* L., known as an efficient HCO_3^- user (Maberly and Spence, 1983), was used as a control for HCO_3^- use. TA in natural and cultivation waters was determined by titration with 0.01 M HCI to the end-point pH of 4.4. CO_2 affinity was determined using a simple " final-pH" test (Allen and Spence, 1981; Maberly and Spence. 1983). Plants were closed in a "liqht bottle" in a solution of a known TA. The final PH reached was a measure of HCO_3^- use and, in HCO_3^- non-users, indicated the CO_2 compensation point of photosynthesis calculated according to the above equations.

Healthy apical parts of the shoots, 4-5 cm long, were placed in 10 ml tubes in the filtrated fishpond water of known TA or in a 1 mM $NaHCO_3$ solution. The tubes were closed with plastic plugs, with an air bubble left inside. The whole internal volume was evenly filled with the plants. The tubes were exposed to natural light in water at temperatures of 21-24 °C. Photosynthetically active radiation (400-700 nm) stayed within the range of 80-120 $W.m^{-2}$, allowing the saturation of photosynthesis. Final pH values were measured after the plants were exposed for 4 h. All experiments were repeated twice and mean values were always stated. The replicates never differed by more than 0.2 pH.

As shown in Table I, the species were not able to alkalize media above a pH of 9.2, which indicates CO_2 use only. The corresponding CO_2 compensation points of *U. australis* and *U. minor* (2.3-4.5 µM) collected from natural sites were lower than those in *U. vulgaris* and *Aldrovanda* (5.9-7.2 gM) cultivated in containers. However, it is not possible to determine whether the latter two species naturally have lower CO_2 affinities or if the results were due to their cultivation conditions. A similar range of values (1.5-6.7 µM CO_2) was also found in *U. purpurea* (Moeller, 1978). These compensation points are consistent with values of 1.5-10 µM generally found in aquatic non-carnivorous plants (Maberly and Spence, 1983). Although the aquatic carnivorous plants usually grow in shallow dystrophic waters with a more or less elevated CO_2 concentration (Komiya. 1966; Adamec, 1993, unpublished), they may also grow in mildly alkaline waters where CO_2 concentration is rather low (Hough and Fornwall, 1988; see also Table I for *U. minor).* Under such conditions, carnivory may be an important means for obtaining additional organic carbon. The extent of this contribution, however, is not known.

The paper is dedicated to Dr. Slavomil Hejny from Prague, Czech Republic, on the occasion of his 70th birthday.

Table I. Alkalization of media as a measure of photosynthetic affinity to CO_2. A, plants collected from natural sites and fishpond water used as the experimental medium; B, the plants cultivated outdoors and 1 mM $NaHCO_3$ solution used. *Myriophyllum spicatum,* an efficient HCO_3^- user, was used as a control. Final $[CO_2]$ corresponds to CO_2 compensation point of photosynthesis. TA in meq.1-1; $[CO^2]$ in µM.

Species and habitat	Growth conditions pH	TA	Expt. TA	Final pH	$[CO_2]$
A.					
U. australis, shallow fen pool	7.2	0.81	1.35	9.2	1.8
U. australis, drainage canal	7.6	0.0	1.35	8.95	3.3
U. australis, dystrophic fishpond	8.3	1.86	1.35	9.15	2.0
U. minor, reed belt of a fishpond	7.2	1.80	1.35	9.1	2.3
U. minor, alkaline fen pool	8.9	3.45	1.24	8.9	3.4
U. minor, alkaline fen pool	8.9	3.45	3.45	9.2	4.5
H. spicatum (control), fishpond	8.3	1.86	1.35	10.9	0.0
B					
U. vulgaris, outdoor cultivation	8.0 ca	1.2	1.00	8.5	7.2
A. vesiculosa, Italian plants. outdoor cult.	7.4 ca	0.5	1.00	8.6	5.9
A. vesiculosa, Polish plants, outdoor cult.	6.9 ca	0.8	1.00	8.5	7.2

REFERENCES

Allen, E. D., Spence, D. H. N. 1981. The differential ability of aquatic plants to utilize the inorganic carbon supply in fresh waters. New Phytol. 87: 269-283.

Arts, G. H. P., Leuven, R. S. E. W. 1988. Floristic changes in shallow soft waters in relation to underlying environmental factors. Freshwater Biol. 20: 97-111.

Ashida, J. 1937. Studies on the leaf movement of *Aldrovanda vesiculosa* L. III. Reaction time in relation to temperature. Bot. Hag. (Tokyo) 51: 505-513.

Fraser D., Morton J, K., Jui P. Y. 1986. Aquatic vascular plants in Sibley Provincial Park in relation to water chemistry and other factors. Can. Field Naturalist 100: 15-21.

Helder R. J. 1988. A quantitative approach to the inorganic carbon system in aqueous media used in biological research: dilute solution isolated from the atmosphere. Plant Cell Environ. 11: 211-230.

Hough R. A., Fornwall M. D. 1988. Interactions of inorganic carbon and light availability as controlling factors in aquatic macrophyte distribution and productivity. Limnol. Oceanogr. 33: 1202-1208.

Juniper B. R., Robins R. J.. Joel D. M. 1989. Carnivorous plants. Pp. 353, Academic Press Ltd, London.

Kadono Y. 1982. Occurrence of aquatic macrophytes in relation to pH, alkalinity, Ca++, Cl$^-$ and conductivity. Jap. J. Ecol. 32: 39-44.

Komiya S. 1966. A report on the natural habitat of *Aldrovanda vesiculosa* found in Hanyu City. Amatores Herb. (Kobe, Japan): 27: 5-13.

Lüttge U. 1983. Ecophysiology of carnivorous plants. In: Lange O. L., Nobel P. S., Osmond C. B., Ziegler H (eds.), Encyclopedia of Plant Physiology, New Series. Vol. 12C. Berlin-Heidelberg-New York, pp. 489-517.

Maberly S. C., Spence D. H. N. 1983. Photosynthetic inorganic carbon use by freshwater plants. J. Ecol. 71: 705-724.

Moeller R. E., 1978. Carbon-uptake by the submerged hydrophyte *Utricularia purpurea*. Aquat. Bot. 5: 209-126.

Sand-Jensen K., Gordon D. M., 1986. Variable HCO_3^- affinity of *Elodea canadensis* Michaux in response to different HCO_3^- and CO_2 concentrations during growth. Oecologia (Berlin) 70: 426-432.

Literature Review

Cheek Martin. 1994. *Pinguicula greenwoodii* (Lentibulariaceae), a new butterwort from Mexico. Kew Bull. 49:813-815.
Yet another new Mexican pinguicula comes to light, this one being most closely related to *P. jackii*, the latter occurring in Cuba and heretofore the only member of Section *Homophyllum*. It is found in a shaded dripping limestone cliff in Oaxaca. The plant's leaves are monomorphic; that is the leaves do not become the typically small, succulent type of other Mexican pinguiculas in winter. The flower is relatively small, pale and bilabiate, the corolla lacks a palate and the leaves are thin and membranous. This brings to a total of 17 new Mexican species since Casper's monograph, most of these in the orchid flowered section where distinctions are often difficult.

Heard, Stephen B. 1994. Pitcher-plant midges and mosquitoes: A processing chain commensalism. Ecology 75:1 647-660.
Working in the field in Newfoundland, the author studied the coexistence of a midge larva (*Metriocnemus knabi*) and a mosquito larva (*Wyeomyia smithii*) in the pitchers of *Sarracenia purpurea* . Trying to determine whether there was competition or not, the author made some interesting studies. The midges sought food by chewing on prey carcasses (mostly ants in this location) deep in the narrow part of the pitcher. The mosquito larvae floated near the fluid surface and are filter feeders, feeding on particles and bacteria excreted by the midge larvae. Thus the mosquito larvae benefitted from the presence of the midges who essentially processed food for them, while the midges gained nothing from the mosquito larvae but did not suffer either. Thus this is an example of what the author calls processing chain commensalism. The author performed several manipulations on over 100 pitchers to discover the relative value of numbers of either larvae, with and without ant food, in pitchers.

Labat, Jean-Jacques, and Paul Starosta (Photography). 1993. L'Univers des plantes carnivores. DuMay, Paris. 140 pp.

IN FRENCH

This is the latest hard cover book addition to the CP literature. The book is nicely jacketed and bound and measures 25 x 31 cm. The first 113 pages are full color photos of at least one per genus of CP, often more, and many of the photos being full page size. Closeups are effective in certain cases such as *Nepenthes* spp. and *Cephalotus* in 25 x

31 cm portraits. The paper quality is excellent as is the photography which is sharp and nicely lighted. While many of the photos are works of art, this does not detract from identification points. The book is printed in Spain, and something unfortunate happened during printing because from p.15 on, many double page color plate sets have an off color cast toward lavender or light purple where there should be red or white. Thus we are treated to a lavender flower of *Dionaea* on p. 25 (should be dead white) or lavender gland hairs, peristomes, etc., all of which should be bright crimson, and so on in many plates. However many other plates are properly hued. Still, this lack of careful control on the part of the printer in a book of this quality in general and of this cost is inexcusable and distracting.

P. 59 offers one of the best shots of *Genlisea* traps, a very difficult subject. The second author is responsible for photography and deserves commendation.

Labeling is remarkably free of error, except in one and possibly two instances. P. 77 is clearly not *Nepenthes truncata* , which is a shame since this quite unique plant would have been a good subject. On p. 67, we are shown *N maxima* , but plants so labeled (or even *N. fusca*) in many collections are really *N x dyeriana*, and I am suspicious of this one.

The remainder of the book is text with “genus pages” following the photo section, written in French, each page devoted to a genus in print size such that quite a lot is covered in one page. The effort is far more successful than the recent tragic LeCoufle English version. The usual factors such as description, species, habitat life cycle and detailed growing tips are covered. My French is limited but those pages I labored through seemed accurate and useful.

Finally, there is a species list, short glossary, a list of important addresses such as societies and sources, and a rather limited bibliography. An index is conspicuously absent, but there is a brief table of contents at the beginning. All in all, this is a sumptuous and also useful production, but the color error takes much the edge off the total effect. I would hope that if a second edition or translation is undertaken, this can be corrected with new plates where called for. The printer is certainly liable.
The price is 450 F, which in US comes to between 85-90 dollars, depending on daily exchange rates. Though only 140 pages and covering the world, the pages are packed full. If one can afford it, and is willing to overlook some of the poor color rendition, this is a useful addition to complete a CP library. The book is available only, as of this writing, through Labat jean-jacques, 32360 Peyrusse Massas, France. They request international postal money order only for 450 F plus whatever mailing you wish.

Schneider, Julio (Transl. Harvey L. Kendall).1995. *Brocchinia reducta :* A carnivorous bromeliad from the Guayana highlands of Venezuela. J. Bromel. Soc. 45:77-83.

This article is an excellent summary of this relatively newly recognized and controversial carnivorous plant. It's close relative, *B. hechtioides*, may also be carnivorous, both among other species in the genus because the leaves grow in full sun in such a way as to produce a tube that is similar to pitcher plants. The article has a general location map, three excellent color photos of plants in habitat, and drawings of absorbant trichomes. There is no enzyme secretion and digestion presumably occurs through bacterial action. Cultivation notes are given and include the need for full sun to elicit the plant's fully developed tubular habit. I have noted that if there is any shade at all, the leaves forming the tube tend to spread. It can be grown in peat/sand in clay pots,

and fertilization is recommended. This article was originally published in German in Der Palmengarten 58/1, 1994.

Seine, Rudiger and Wilhelm Barthlott. 1994. Some proposals on the infrageneric classification of Drosera L. Taxon 43:583-589.
These authors present a nest subgeneric grouping classification for sundews. They recognize three subgenera: D. regia in it's own subgenus, those plants without tubers (seven sections) and those plants that are tuberous (three sections). The paper includes a key for all three subgenera and ten sections.

Tan, Tommy H. 1994. Dewe of the Sonne — The carnivorous sundew plant. Nature Malaysiana 19:75-77.
This is a brief review of sundews it Malaysia, focusing on *Drosera spathulata* including three color photos, mention of the three variants of the species, and a short description of its carnivorous activity. The particular plants described are in Bako National Park.

Weihee, ER and CW Boylen. 1994. Alterations in aquatic plant community structure following liming of an acidic Adirondack lake. Can. J. Fish. Aquat. Sci. 51:20-24.

Those who follow the environment recall that acid rains have acidified many lakes in the northeastern United States in particular. Such lakes are described as clarified and quite blue and pristine in appearance but there have been drastic reductions in animal life. Several of us have wondered if CP populations may not actually be helped by this acidification process, and damaged by attempts to dump alkalinizing agents into lakes to bring them back to circumneutral pH.

In this case, calcite was added and over a period of several years, this particular acid lake was brought back to circumneutral pH. During this process, sphagnum disappeared along with *Utricularia geminiscapa*, but *U. purpurea* only decreased to 3-30% of its former level in the previously acidified lake. Curiously, *U. resupinata* along the shoreline showed no significant change at all. Further followup on other lakes, particularly those with a shoreline sphagnum mat containing *Sarracenia purpurea* , would be of interest.

EDITORAL NOTE

I wish to apologize for the large number of spelling, typo, dangling phrase, etc. errors in my articles in the March, 1995 issue of CPN. I assure you that all copy left my desk in perfect order. The problem is that Steve's and my computers cannot read each other's disks so I submit material as printouts which Steve places in his computer by using a scanner. This process is also used for anyone else's printouts or typewritten manuscripts since hand keying the entire article is quite laborious and still prone to human errors.
Scanners are remarkable devices but they cannot "read" everything accurately, hence the numerous errors in the March and portions of preceding issues. The obvious solution: After scanning, Steve will make a printout of what he has and send it on to me for proofreading so he can key in corrections prior to setting up pages in his computer. This process will apply to anything sent in by anyone that requires scanning. Thank you for your patience.

Don Schnell